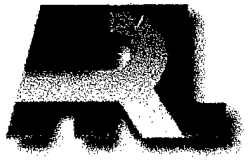


Army Research Lab

Wind Sensing - The Sniper's Essential Cue

Raymond Von Wahlde

Army Research Lab
Kent Building (120)
APG, MD 21005-5066
(410) 278 - 9738
vonwahld@arl.mil

1998 Small Arms Systems Section Annual Conference, Exhibition & Firing Demonstration

Columbus, Georgia

Advanced Weapons Concepts Branch, BWCD

Army Research Lab

Importance of Knowing Cross Wind

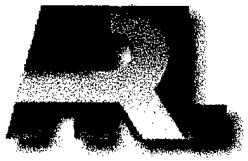
- Joint Service Small Arms Program (JSSAP) 1993 Sniper Conference

- "What is the single most difficult challenge that you face in successfully engaging a target at long range?"

» "*Wind* and all elements."; Carlos Hathcock, USMC (ret)

» "*Wind* and distance (estimation)."; Ken Howard, SEAL

» "*Wind* reading."; D.J. Riddle, USMC



Army Research Lab

Cross Wind Estimation

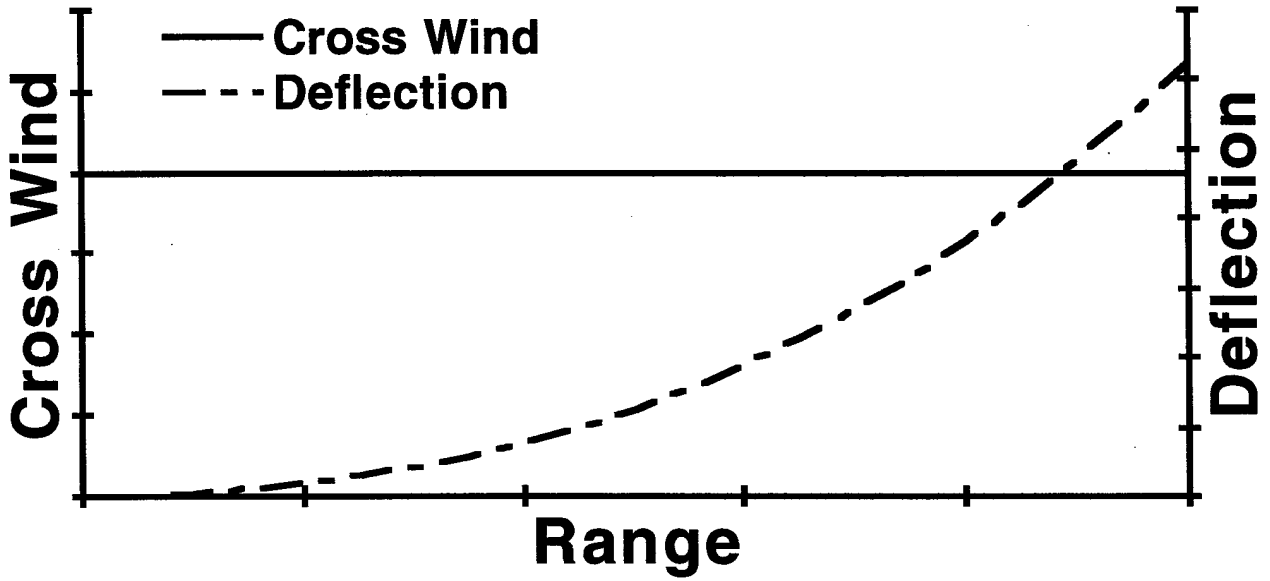
- The horizontal component of the wind vector perpendicular to the line-of-fire.
  - » Estimate speed and direction
  - » Measurment at his location
  - » Observing Environment, (foliage motion, dust, etc.)
  - » Shimmer or mirage
  - » "Kentucky Windage"

- **Tacit Assumption:**

  Cross Wind is Constant vs. Range

Army Research Lab

Cross Wind Deflection



$$Z = W_Z * (t - R / V_0)$$

Z = Deflection W_Z = Cross Wind Speed

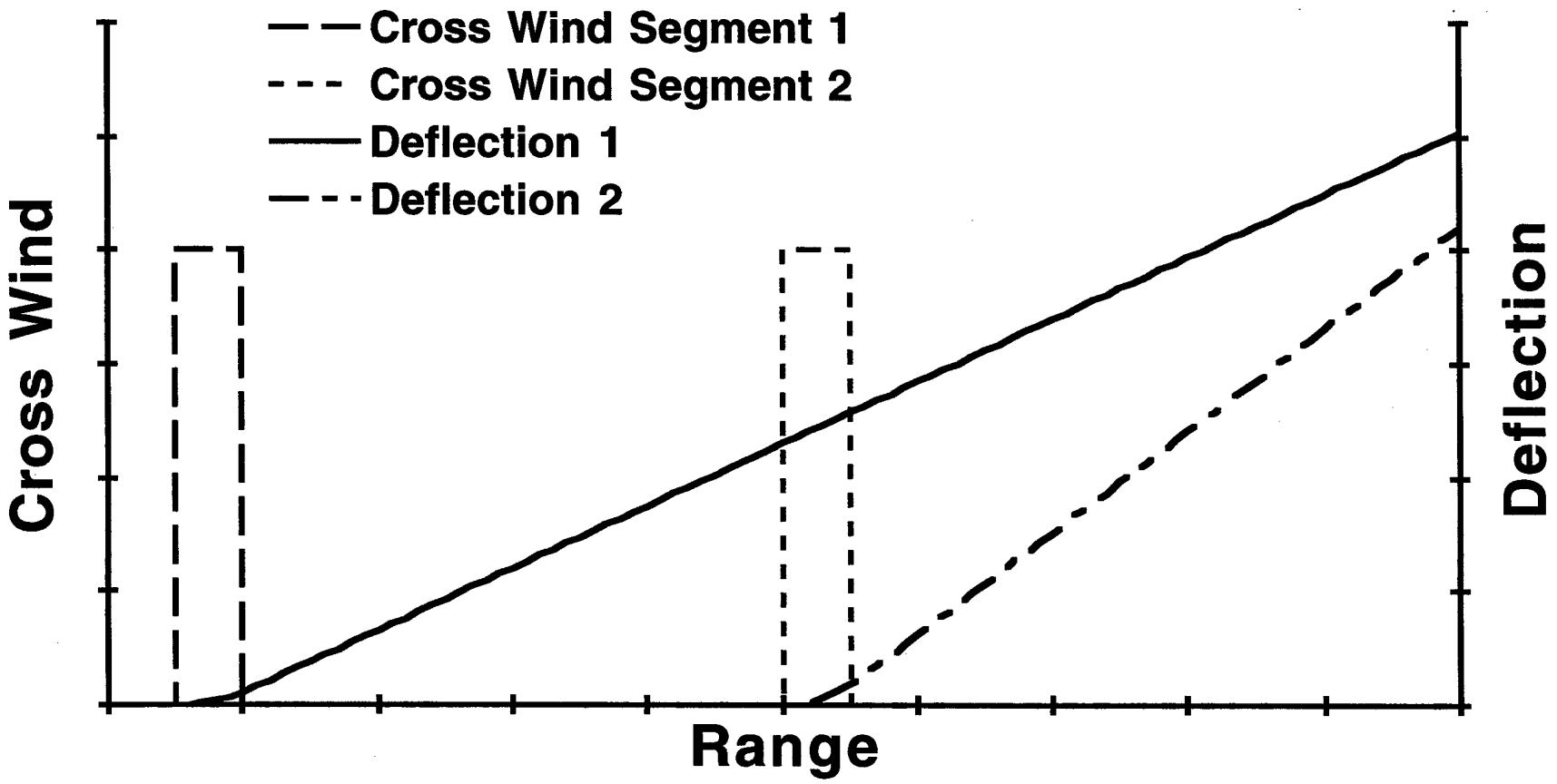
R = Range t = Time of Flight to R

V_0 = Starting Velocity

e.g.: 1 m/s CW, .300 WinMag, 884 m/s MV, 1.75 TOF, .62 m at 1000m

Army Research Lab

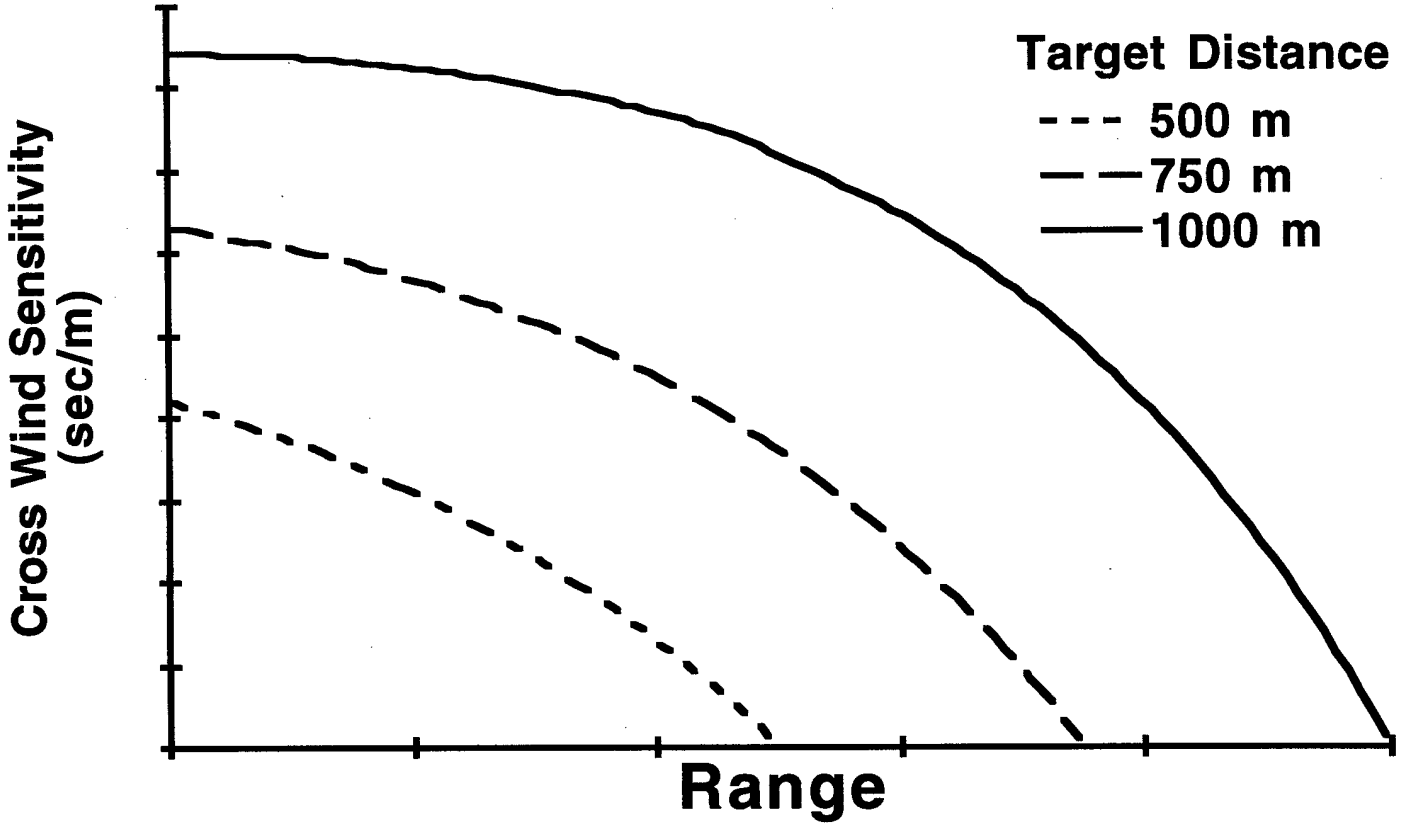
Cross Wind Sensitivity



Army Research Lab

Cross Wind Sensitivity

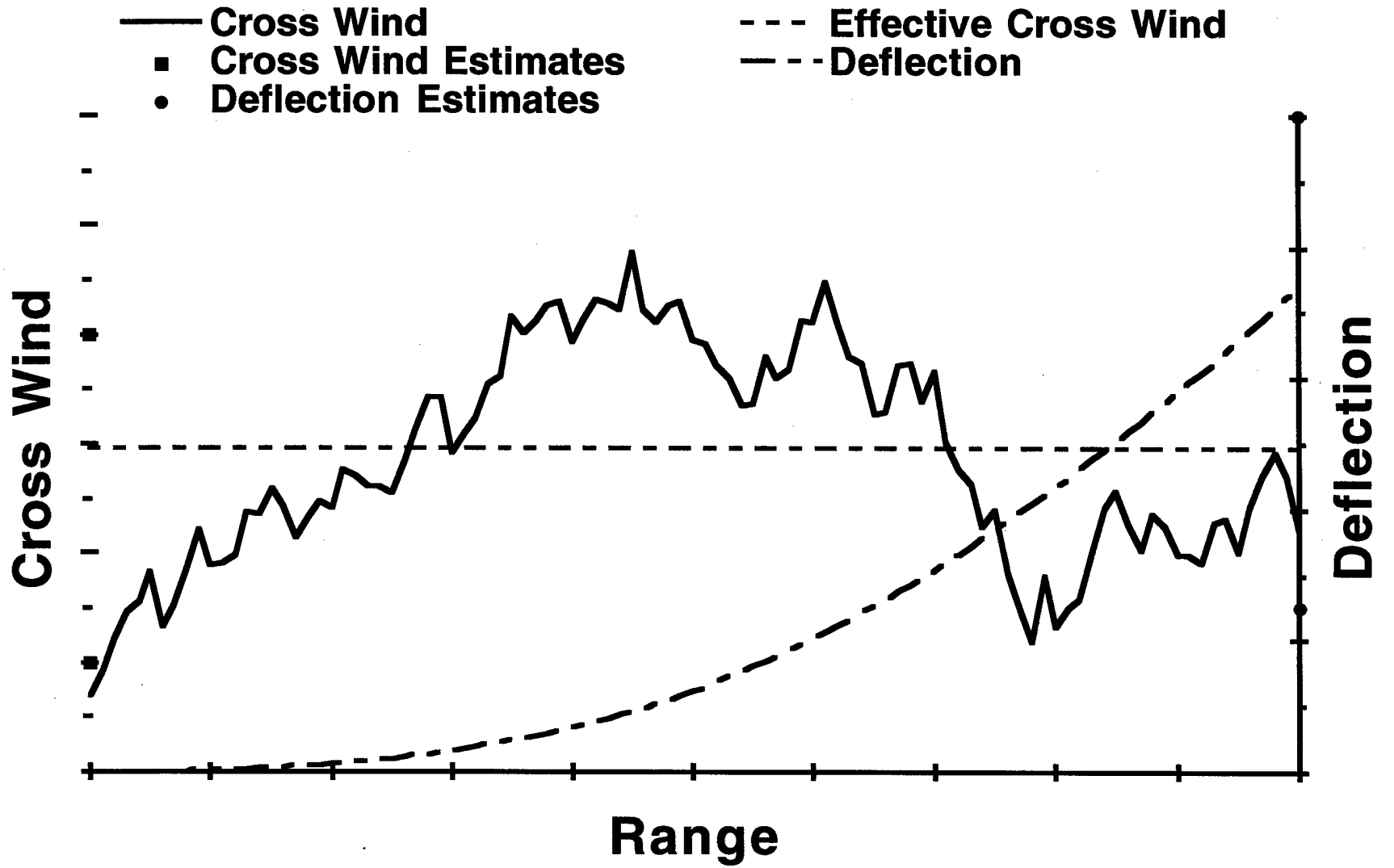
- (Deflection at Target Distance) / (Cross wind speed) / (Wind width)



- Bullet is more sensitive to cross winds nearest shooter.

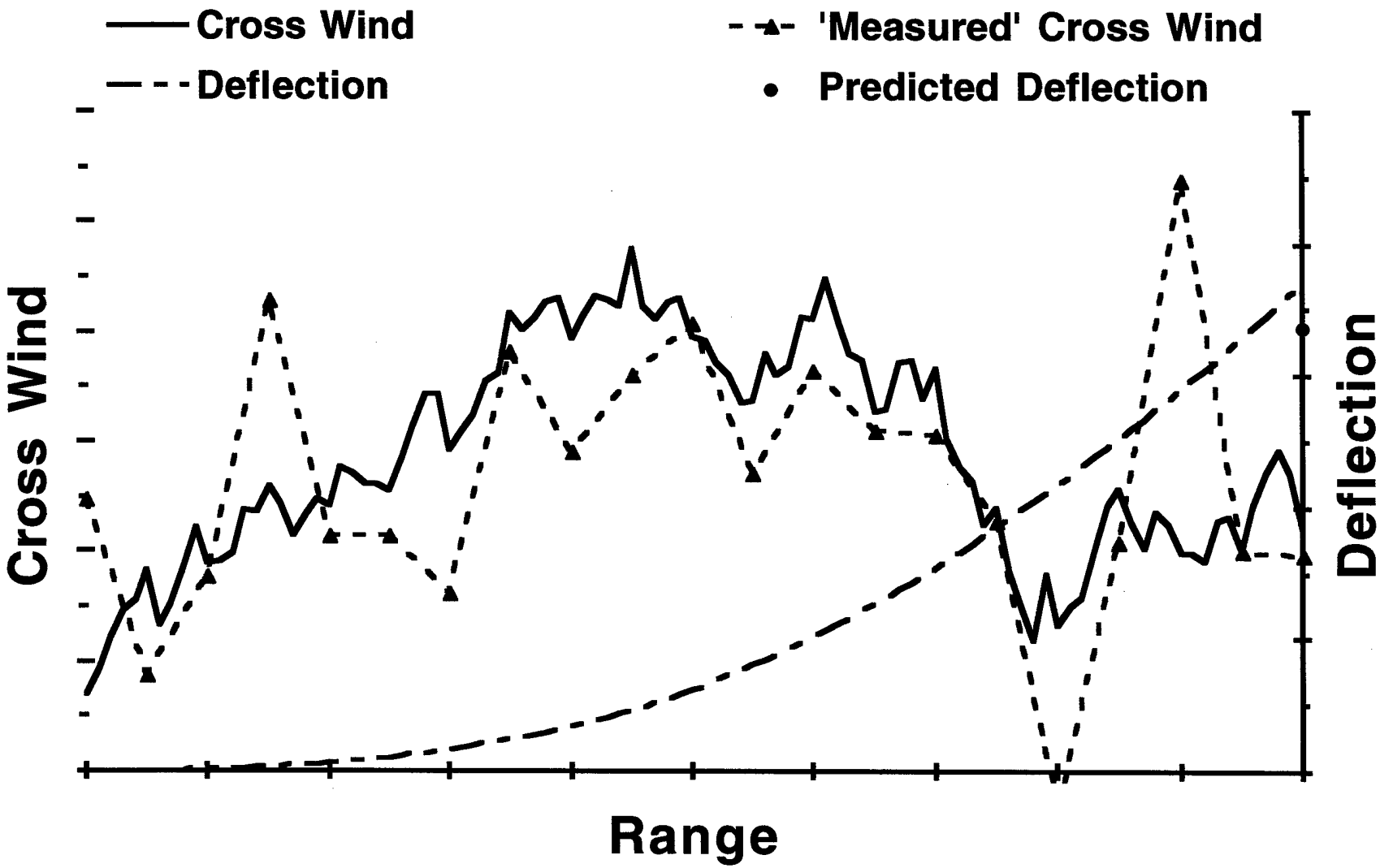
Army Research Lab

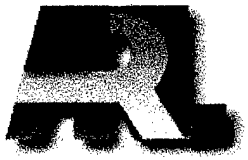
Variable Cross Wind



Army Research Lab

Cross Wind Measurement





Army Research Lab

Laser Cross Wind Sensor SBIR

- **Small Business Innovative Research (SBIR) topic: A96-032**
  TITLE: Laser Cross Wind Sensor
- **OBJECTIVE: Develop and demonstrate**
  - » **a compact,**
  - » **lightweight,**
  - » **rugged,**
  - » **eye-safe,**

  wind sensor capable of measuring cross wind profiles for ballistic wind corrections.
  - » **real time**
  - » **1 m/s accuracy**
  - » **1500 m**
  - » **range wind and range to target desirable.**
- **Four Phase I contracts.**
- **Three Phase II contracts.**

Army Research Lab

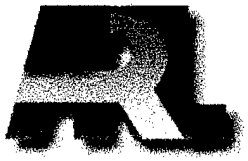
LASER Cross Wind Sensing Techniques

Laser Doppler Velocimetry

- Range-resolved, aerosol velocities measured along laser beams
- Divergent beams directed to sides of firing line
- Transformed into Range and Cross Wind Components
- Advantage:
  - Range-resolved Cross Wind
- Disadvantage:
  - Divergent beams
- Issue:
  - Transformation

Laser Scintillation

- Akin to "mirage" windage technique
- Laser-illuminated target
- Distortion of "speckle" pattern gives "ballistically" weighted reading of intervening cross wind.
- Advantage:
  - Directed along line of fire
- Disadvantage:
  - Weighted average
- Issue:
  - Multi Weighted Readings



Army Research Lab

LASER Cross Wind Sensing SBIR Contractors

Laser Doppler Velocimetry

Optical Air Data Systems

- Fiber optic components
- Ultra-compact system
- Unique signal processing technique

Phil Rogers (301) 299-6197
P.O. Box 34601 West Bethesda, MD 20827
PROGERS_OADS@msn.com

Coherhent Technologies Inc.

- Bulk laser components
- Velocity pattern algorithm
- Potential for smaller angle
- Confidence level of measurement shown
- Longer update time

Phil Gatt (303) 604-2000
655 Aspen Ridge Dr. Lafayette, CO 80026
PHILG@ctilidar.com

Laser Scintillation

Scientific Technologies Inc.

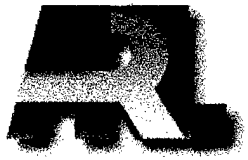
- "Fast Track" proposal
- Matching dollars
- Fewer weighted readings

Dr. Ting-i Wang (301) 948-6070
205 Perry parkway, Suite 14
Gaithersburg, MD 20877
scti@netrail.net

Brimrose

- Actual demonstrated prototype
- Live fire tests
- More weighted readings

Dr. Susan Kutcher (410) 931-7200
5020 Campbell Blvd. Baltimore, MD 21236
office@ brimrose.com



Army Research Lab

Laser Cross Wind Sensor

- Utilize fiber optic components.
- Be incorporated into a spotting scope.
- Use Scintillation technique for cross wind and doppler technique for range wind.
- Provide a cross wind correction to the spotter.
- Also function as a laser range finder.
- Eye-safe.